

International Energy Module

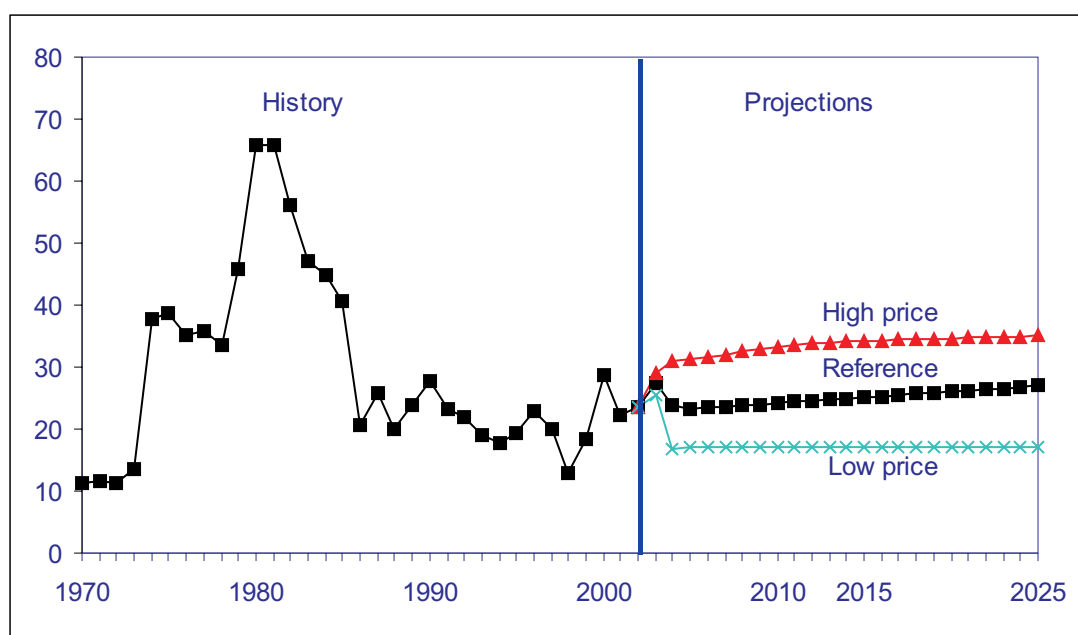
The International Energy Module determines changes in the world oil price and the supply prices of crude oils and petroleum products for import to the United States in response to changes in U.S. import requirements. A market clearing method is used to determine the price at which worldwide demand for oil is equal to the worldwide supply. The module determines new values for oil production and demand for regions outside the United States, along with a new world oil price that balances supply and demand in the international oil market. A detailed description of the International Energy Module is provided in the EIA publication, *Model Documentation Report: The International Energy Module of the National Energy Modeling System*, DOE/EIA-M071(03), (Washington, DC, May 2003).

Key Assumptions

The level of oil production by countries in the Organization of Petroleum Exporting Countries (OPEC) is a key factor influencing the world oil price projections incorporated into AEO2004. Non-OPEC production, worldwide regional economic growth rates and the associated regional demand for oil are additional factors affecting the world oil price.

The world oil price is the annual average U.S. refiner's acquisition cost of imported crude oil. Three distinct world oil price scenarios are represented in AEO2004, the low world oil price, reference, and high world oil price cases in which prices reach \$17, \$27 and \$35 per barrel in 2025, respectively, in 2002 dollars. The reference case represents EIA's current judgment regarding the expected behavior of the Organization of Petroleum Exporting Countries (OPEC) in the mid-term, where production is adjusted to keep world oil prices in the \$22 to \$28 per barrel range. Since OPEC, particularly the Persian Gulf nations, is expected to be the dominant supplier of oil in the international market over the mid-term, the organization's production choices will significantly affect world oil prices. The low world oil price case could result from a future market where all oil production becomes more competitive and plentiful. The high price case could result from a more cohesive and market-assertive OPEC with lower production goals and other nonfinancial (geopolitical) considerations. The three price scenarios are shown in Figure 2.

Figure 2. World Oil Prices in Three Cases, 1970-2025
(2002 dollars per barrel)

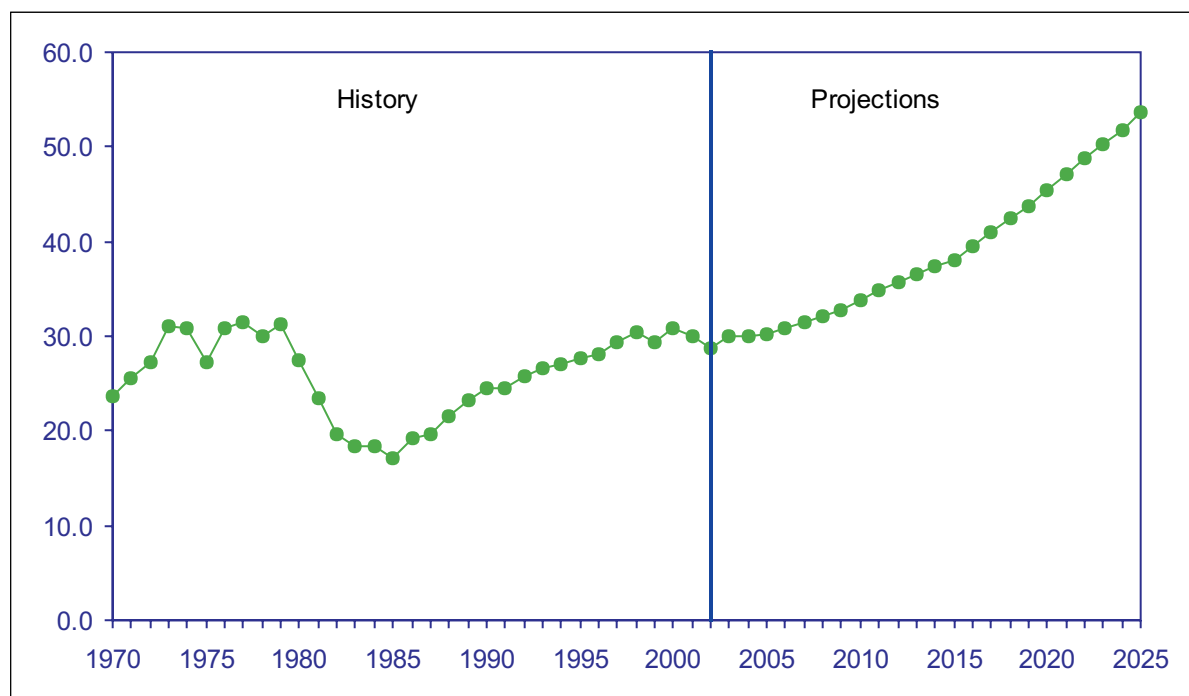


OPEC = Organization of Petroleum Exporting Countries.

Source: Energy Information Administration. AEO2004 National Energy Modeling System run aeo2004.d101703e.

OPEC oil production is assumed to increase throughout the reference case forecast, making OPEC the primary source for satisfying the worldwide increase in oil consumption expected over the forecast period (Figure 3). OPEC is assumed to be the source of additional production because its member nations hold a major portion of the world's total reserves—exceeding 819 billion barrels, more than 67 percent of the world's estimated total, at the end of 2002.⁴ The reference case values for OPEC production are shown in Figure 3. Iraq is assumed to sell oil at approximately pre-conflict volumes until 2005. They are expected to increase production levels to over 4 million barrels per day by the end of the decade. By 2025, Iraq is expected to increase production capacity to more than 6 million barrels per day with likely investment help from foreign sources. Non-OPEC oil production is expected to increase by almost 1.3 percent per year over the forecast period, as advances in both exploration and extraction technologies result in an upward trend. The Non-OPEC production path for the reference case is shown in Figure 4.

Figure 3. OPEC Oil Production in the Reference Case, 1970-2025
(Million Barrels per Day)



OPEC = Organization of Petroleum Exporting Countries.

Source: Energy Information Administration. AEO2004 National Energy Modeling System run aeo2004.d101703e.

The non-U.S. oil production forecasts in the *AEO2004* begin with country-level assumptions regarding proved oil reserves. These reserve estimates are taken from PennWell Publishing Company's *Oil and Gas Journal* and are shown in Table 4.

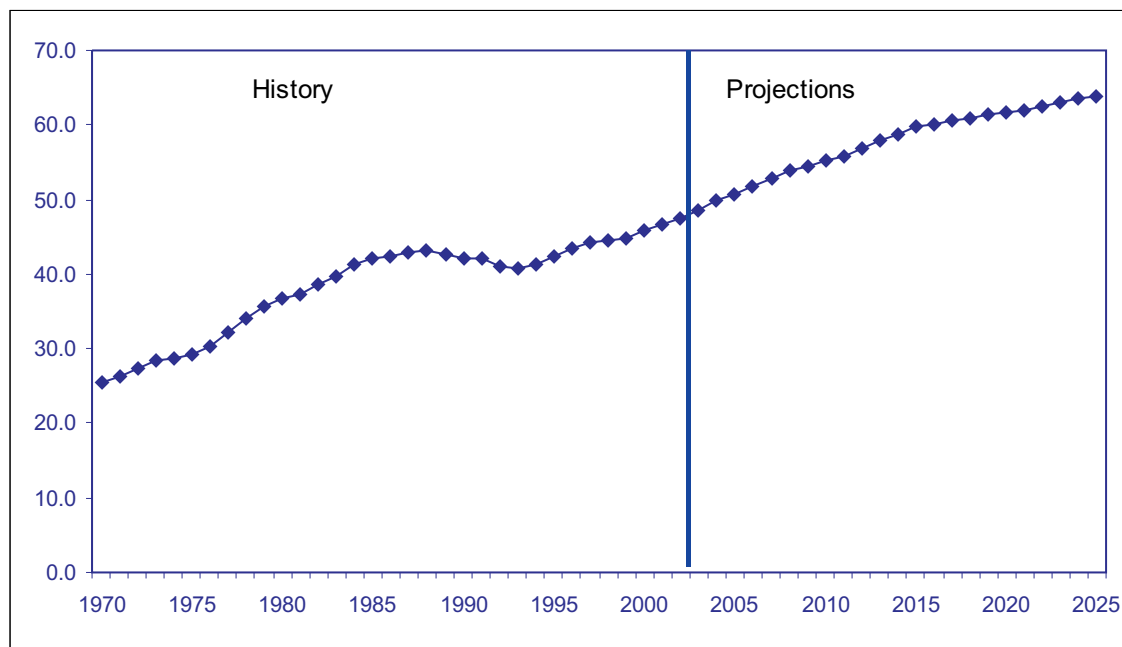
The assumed growth rates for GDP for various regions in the world are shown in Table 5. The same GDP growth rates are applied in all three world oil price cases. The GDP growth rate assumptions are from Global Insight's DRI-WEFA August 2003 World Economic Outlook.

The values for growth in oil demand calculated in the International Energy Module, which depend upon the oil price levels as well as the GDP growth rates, are shown in Table 6 for the reference case by regions.

Petroleum product imports are represented in the projections through a series of curves that present the quantity of each product that the world market is willing to supply to U.S. markets for each of the five Petroleum Administration for Defense Districts (PADDs). Curves are provided for twelve products: traditional gasoline (including aviation), reformulated gasoline, reformulated gasoline blending stocks for oxygenated blending (RBOB), traditional distillate fuel, low-sulfur No. 2 heating oil, low-sulfur diesel fuel, high- and low-sulfur residual fuel, jet fuel (including naphtha jet), liquefied petroleum gases, petrochemical feedstocks, and other petroleum products. The curves are calculated using the World Oil Refining Logistics

Demand (WORLD) Model.⁵ The WORLD model uses as inputs worldwide demand for crude oil and petroleum products based on world oil prices that are close to the oil prices assumed for *AEO2004*, as well as values for worldwide petroleum production that are consistent with such prices. The refinery technology incorporated in the model is updated using the most recently available Oil & Gas Journal Database.⁶

Figure 4. Non-OPEC Production in the Reference Case, 1970-2025
(Million Barrels per Day)



OPEC = Organization of Petroleum Exporting Countries.

Source: Energy Information Administration. AEO2004 National Energy Modeling System run aeo2004.d101703e.

Table 4. Worldwide Oil Reserves as of January 1, 2002
(Billion Barrels)

| Region | Proved Oil Reserves |
|---------------------------|---------------------|
| Western Hemisphere | 313.6 |
| Western Europe | 18.1 |
| Asia-Pacific | 38.7 |
| Eastern Europe and F.S.U. | 79.4 |
| Middle East | 685.6 |
| Africa | 77.4 |
| Total World | 1212.9 |
| Total OPEC | 819.0 |

Source: PennWell Publishing Co., International Petroleum Encyclopedia, (Tulsa, OK, 2002).

Table 5. Average Annual Regional Gross Domestic Product Growth Rates, 2001-2025
(Percent per Year)

| Region | Gross Domestic Product Growth |
|----------------------------|-------------------------------|
| Industrialized Countries | 2.6 |
| Other Developing Countries | 4.1 |
| Eurasia | 5.3 |
| China | 6.2 |
| Former Soviet Union | 3.8 |
| Eastern Europe | 4.2 |
| Total World | 3.1 |

Source: Global Insight's DRI-WEFA, World Economic Outlook, (Lexington, MA, August 2003).

Table 6. Average Annual Regional Growth Rates for Oil Demand in the Reference Case, 2002-2025
(Percent per Year)

| Region | Oil Demand Growth |
|----------------------------|-------------------|
| Industrialized Countries | 1.2 |
| Other Developing Countries | 2.4 |
| Eurasia | 2.7 |
| China | 3.3 |
| Former Soviet Union | 1.9 |
| Eastern Europe | 2.5 |
| Total World | 1.8 |

Source: Energy Information Administration, *AEO2004* National Energy Modeling System run: aeo2004.d101703e.

Notes and Sources

[4] PennWell Publishing Co., International Petroleum Encyclopedia, (Tulsa, OK, 2003).

[5] EIA, EIA Model Documentation: World Oil Refining Logistics Demand Model, "WORLD" Reference Manual, DOE/EIA-M058, (Washington, DC, March 1994).

[6] Oil & Gas Journal, World Wide Refinery Survey, (data as of January 1, 2003).